Outcomes of N-butyl cyanoacrylate use in cases where incidental durotomy developed in lumbar disc herniation surgery

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Abstract

Aim: Incidental durotomy (ID) occurred during lumbar disc herniation surgery is one of the most frequently encountered surgical complications. Different methods have been defined related to the repair of durotomy during the perioperative period. The author explains the use and results of n-butyl cyanoacrylate (NBCA) which is one of the agents used for repair of ID. Material and Method: The records of cases that ID developed and that were operated due to lumbar disc herniation were retrospectively reviewed and their results were discussed. Totally 29 cases were operated using the described method. All durotomy defects were less than 1cm. None of ID's were repaired with primary suturation. NBCA (Glubran 2®) was conveyed to regions by the method of instillation and covered as a thin layer. Results: All cases were mobilized next morning after the surgery. The average time elapsed until the discharge is 2,8 days. Postoperative subcutaneous cerebrospinal fluid (CSF) collection development was detected in 1 case and treated with the conservative method. In 2 cases paresthesia which started in the early postoperative period and treated with pregabaline 50 mg for one month period. Discussion: NBCA is a fast and effective preventive preparation for cases where ID developed in lumbar disc herniation surgeries. It strongly sticks to the dura and doesn't break away or meltdown. NBCA allows early mobilization in the postoperative period and does not have any compressive effect on root if it covers the dural defect as a thin layer. If it is used appropriately, the results are very satisfactory.

Keywords

Incidental Durotomy; CSF Fistula; Lumbar Disc Herniation; Complication; Glubran 2

DOI: 10.4328/JCAM.5920 Received: 02.06.2018 Accepted: 16.06.2018 Published Online: 19.06.2018 Printed: 01.11.2018 J Clin Anal Med 2018;9(6): 517-20
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Introduction

Incidental durotomy (ID) which occurred during lumbar disc herniation surgery is one of the most frequently encountered surgical complications. If it is not treated, it may cause intracranial hypotension which results from cerebrospinal fluid (CSF) leakage and may also cause intracranial hemorrhage with a severe headache [1,2]. Meningitis, pseudomeningocele and low back pain are other complications which can be encountered in the early and long- term follow-up period [1]. Due to a different methods ID did not cause CSF fistula in the postoperative period. Although repair with primary suturation is the most reliable method, the small area of the surgery makes the repair difficult using this method. Methods such as a blood-soaked gel foam, fibrin adhesive, muscle or collagen matrix graft application have also been applied [3]. Immobilization, bed rest in the prone position and lumbar drainage methods have also been tried in order to prevent more CSF leakage [4].

In this study, we present our experience regarding the efficacy of n-butyl cyanoacrylate (NBCA) in preventing CSF fistula during lumbar disc herniation surgery.

Material and Method

Totally 29 cases had an ID during the surgery and the defect was repaired by NBCA (Glubran 2®). Microdiscectomy was performed in total 31 levels. The percentage of incidental durotomy during lumbar disc herniation surgery was 3,3% between years 2013-2017. Five of the cases were operated on due to recurrent lumbar disc herniation. Unilateral microdiscectomy with foraminotomy method was routinely performed in 28 of 29 cases. Demographic characterization of the cases was shown in Table 1.

Table 1. Demographic characterization of the cases.

Age average:	47,2 (interval: 33-67)
Sex:	Male: 13 (44,8%) Female: 17 (51,2%)
Level:	L3-L4: 2 (6,9%) L4-L5: 12 (41,4%) L5-S1: 15 (51,7%)
Pre-operative Clinical Symptoms/Findings:	Radicular Pain: 24 (82,7%) Motor deficit: 4 (13,8%) Sensory deficit: 14 (48,3)

One case was operated with total laminectomy and bilateral microdiscectomy. During laminectomy and flavum excision, Kerrison Rongeurs no 2 and no 3 were used. Discectomy was performed with no 2 straight and 45 degree angled pituitary rongeurs. ID occurred during hemilaminectomy in 2 cases, during discectomy in 15 cases, before discectomy in 5 cases, during posterior longitudinal ligament incision in 7 cases. ID occurred in anterolateral in 2 cases, on lateral in 15 cases and in posterolateral of the dural sac in 12 cases.

(Ethics Committee Approval was obtained from Ahi Evran University Clinical Research Ethics Committee No:2017-13/140).

Surgical Technique:

The size of the ID was less than 1cm in all cases. Primary suturation has not been applied in any case for dural repair. When the discectomy procedure finished, NBCA application for dural repair had been made under microscope in all cases. During application on the dural defect, cerebrospinal fluid (CSF) was suctioned (Figure 1) and the surface of dura was kept dry and NBCA was applied quickly by using the dripping method from several cm highs. By means of the dripping method, spreading of the NBCA on the defect as a thin layer was ensured. Two minutes later, positive end expiration pressure (PEEP) was performed for approximately 5-8 seconds 3-5 times with short intervals and it was confirmed whether there was any CSF leakage or not. No additional material has been used along with NBCA (Figure 2).

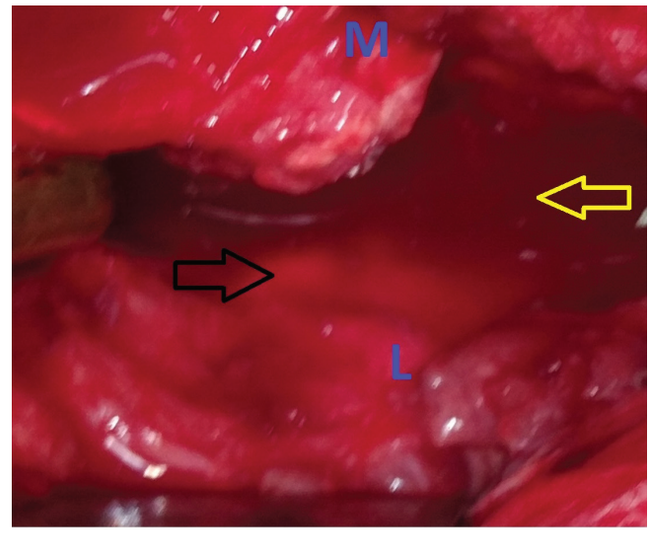

Figure 1. CSF leakage during surgery. After aspirating CSF, NBCA should be applied on dural defect immediately (Dural sac: black arrow, CSF: yellow arrow, M: medial, L: lateral)

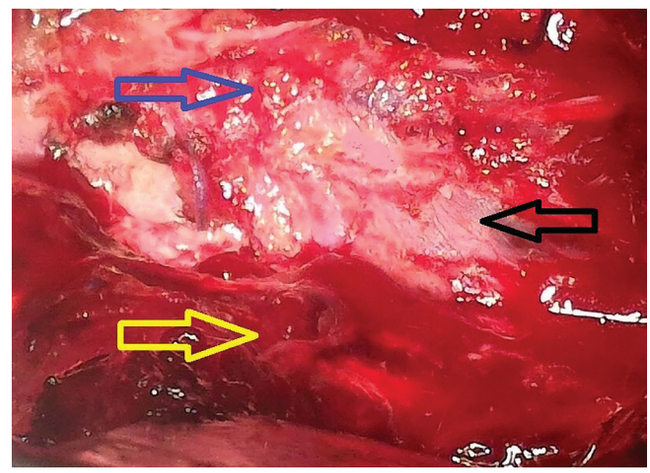

Figure 2. After the application of NBCA as a thin layer. It dried quickly and it was waited for 2-3 minutes for better adhesive effect (Dural sac: blue arrow, Thin layered NBCA: black arrow, paraspinal muscles: yellow arrow).

NBCA dries very quickly. For this reason, by means of the dripping method through the applicator, NBCA covers the defect with small volumes. Since NBCA dries very quickly and it has strong adhesion property, contact with the suction was avoided. For anterior and anterolateral dural defects NBCA was dripped from the height of several cm to the edge of the dural defect. When NBCA couldn't cover the defect, a small and thin absorbable hemostatic material (oxidized cellulose) was left on the defect and NBCA was dripped on this material. For posterior defects, dural edges were approximated with an elevator to

avoid NBCA leak into the subarachnoid space. In case of CSF leakage was observed with PEEP, NBCA was re-applied to the leakage point.

Results

All of the cases have been followed up on a routine schedule for lumbar microdiscectomy cases. None of the cases was allowed to lie in the prone position. Supine and side-lying position was recommended. Each case was mobilized next morning after the operation. CSF leak through the incision or subcutaneous collection was ruled out before early mobilization. It was not recommended to use corsets for any of the cases. A severe headache was observed in 17 cases in the early post-operative period, hydration with physiologic saline and paracetamol caffeine treatment was administered for headache due to intracranial hypotension, which resolved within a couple of days. Cefazolin (3x1g intravenous) for one day in the post-operative period was given to each case. Hypersensitivity reaction and CSF leakage on the skin were not seen in any case during hospital stay. The average post-operative hospitalization was 2,8 days.

Outpatient visit of cases was carried out on 10th-12th days after discharge. Subcutaneous CSF collection was detected in 1 case. CSF collection was evacuated with needle puncture and the case recommended to use elastic corsets and restrict daily activities. Amoxicillin clavulanate (1gr) antibiotherapy was administered for one week. On 24th post-operative day, the problem was totally resolved. Twenty-one of the cases had control MRI (Figure 3) and no pseudomeningocele was observed in any case in the postoperative period (average follow-up time was 3,6 months). In 2 cases, neuropathic pain was developed at the pre-operative radiculopathy side. In these cases, after 50 mg of pregabalin treatment, almost all of the complaints disappeared after 1 month. Neuropathic pain was not developed in any case with ID at posterior or lateral group.

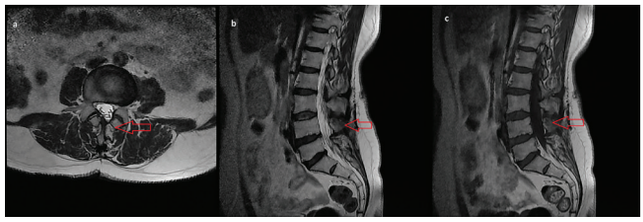

Figure 3. Postoperative 2nd month MRI of operated L4-5 disc herniation and repaired incidental durotomy. Laminectomy level on left L4-5 (a) (surgery level: red arrow).

Discussion

CSF leakage during lumbar disc herniation surgery is one of the most frequently encountered complications. Older age, thinning of dura due to chronic compression, previous operation in the same area and surgical experience are the defined risk factors associated with ID [5]. If it is not treated, CSF leakage can lead to complications such as postural headache, nausea, dizziness, photophobia, tinnitus and intracranial hemorrhage, meningitis, pseudomeningocele, which are caused by intracranial hypotension [1,2]. Bed rest in the prone position is one of the conservative treatment methods [5,6].

Different surgical methods have been applied to cases which cannot be treated conservatively. Such methods as covering of the dural defect with fatty tissue and fascial graft [5,6], closed drainage system application [7], epidural blood-patch application [8], the use of metallic clips [9,10], the use of collagen matrix [11] and dural adhesive agents [12,13] are also used. It is aimed that these agents do not cause a compressive effect on the root or dural sac, while they prevent CSF leakage.

Although primary repair is the most reliable method, it is difficult because of a narrow area of the surgery [1,6,14]. Different dural adhesive agents are used for ID repair for cases where the primary repair is not possible or preferred in the intraoperative period. In case it is difficult to repair by sewing the narrow surgical site, the use of these preparations provides convenience to the surgeon. However, the use of such preparations may result in root compression or, root compaction in the foramen, or adhesion of the root to near tissues. NBCA which can also be used for repair in ID cases is a preparation which is quickly able to stick to bones and surrounding tissues, which has minimal or no toxicity over the nerve or vascular structure and which is easy to apply and which has bactericidal properties [15]. However, it has been identified that it had toxic effects on neural tissue [16]. After the NBCA is undergone polymerization in the tissue applied, it can cause heat increase and can convert into acryl acetate and formaldehyde [17,18]. However, areas where NBCA can be used for the prevention of CSF fistula after transsphenoidal surgery [19], endovascular treatment of arteriovenous malformations except neurosurgery [20], treatment of gastric varices [21], treatment of urinary fistula [22] and treatment of aortic dissection [23].

Although no neurological deficit developed in any of the 29 cases with advanced ID, paresthesia which is felt like burning occurred in 2 cases where NBCA was in contact with the root during the repair of the dura. Metabolites that occur during polymerisation of the material can cause paresthetic complaints on the root. This type of paresthesia has not been seen in cases where the root is distant, where ID developed in the dural sac and where NBCA was not in contact with the root. It was thought that side effects have occurred when NBCA directly contacts nerve tissue because the additional neurological symptom has not developed in any case. For this reason, when NBCA directly contacts with neural tissues or CSF, it may increase side effects, thus, it should be used carefully. It has not caused hypersensitivity during follow-up periods. It enables mobilization in the early period. As soon as it is applied, its effect can be seen immediately and it becomes a very strong adhesive. During the surgery, must be cared of adhesions to other tissues for a few seconds until NBCA dries.

During lumbar disc herniation surgery, dura is not always torn with neat edges. The repair of the leaves of dura that have been torn unshapely, with the method of primary suturation, is difficult in that narrow area. These are the situations where the use of dural glue provides convenience to the surgeon. It is thought that even the method of primary repair could not prevent CSF fistula to match the low rate seen with the described method.

Conclusion

NBCA is a fast and effective preventive preparation for cases in which the incidental durotomy developed in lumbar disc herniation surgeries. This agent considerably shortens the duration of

surgery which is necessary for dural repair and does not have any compressive effect on root when it covers the dural defect as a thin layer. It provides mobilization in an early postoperative period, thus highly satisfactory results are obtained by its appropriate use.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:
Asan Z. Outcomes of N-butyl cyanoacrylate use in cases where incidental durotomy developed in lumbar disc herniation surgery. J Clin Anal Med 2018;9(6): 517-20.